Molecular and magnetic resonance imaging of human embryonic stem cell-derived neural stem cell grafts in ischemic rat brain.

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Public Summary:
Real-time imaging of transplanted stem cells is essential for understanding their interactions in vivo with host environments, for tracking cell fate and function and for successful delivery and safety monitoring in the clinical setting. In this study, we used bioluminescence (BLI) and magnetic resonance imaging (MRI) to visualize the fate of grafted human embryonic stem cell (hESC)-derived human neural stem cells (hNSCs) in stroke-damaged rat brain. The hNSCs were genetically engineered with a lentiviral vector carrying a double fusion (DF) reporter gene that stably expressed enhanced green fluorescence protein (eGFP) and firefly luciferase (fLuc) reporter genes. The hNSCs were self-renewable, multipotent, and expressed markers for neural stem cells. Cell survival was tracked noninvasively by MRI and BLI for 2 months after transplantation and confirmed histologically. Electrophysiological recording from grafted GFP(+) cells and immuno-electronmicroscopy demonstrated connectivity. Grafted hNSCs differentiated into neurons, into oligodendrocytes in stroke regions undergoing remyelination and into astrocytes extending processes toward stroke-damaged vasculatures. Our data suggest that the combination of BLI and MRI modalities provides reliable real-time monitoring of cell fate.

Scientific Abstract:
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